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Composite Frame Member and Frame for a Wheelchair

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CROSS REFERENCE TO RELATED APPLICATIONS

Priorities are claimed of the European patent application 03 004 733.6, as filed on 4 March 2003, and the European patent application 03 027 238.9, as filed on 28 November 2003, incorporated herein by reference.

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The present invention relates to an L-shaped frame member for a wheelchair in accordance with claim **1** and a frame for a wheelchair in accordance with claim **12**.

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FIELD AND BACKGROUND OF THE INVENTION

Wheelchairs usually have frames comprising frame members which are made of bent tubes. Many frames comprise a knee-like frame member having the form of an inversed letter L, with a first tube portion being essentially horizontal and a second tube portion being essentially vertical. The angle between the first and second portions may differ considerably from 90°, and the two frame portions adjacent the corner portion are not necessarily totally straight but may be slightly bent too, although with a curvature which is considerably smaller than the curvature of the corner area where they meet.

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Frames of this type are practical, esthetic, easy to make and not costly, but frame members in the form of a letter L have a severe drawback: the stress-resistance of the different portions is not adjusted to the stress they have to bear. The maximum stress is in the corner area where the two arms of the letter L meet, while the stress resistance in this area is reduced due to the bending operation. Further, the stress to be supported by the upright arm usually is lower than the stress to be supported by the horizontal arm, yet the stress resistance of both arms is equal. In consequence, a tube must be chosen having a stress resistance which is high enough, also in bent state in the corner area of the letter L, to support the maximum stress. Such a tube is over-dimensioned in view of its stress resistance for the arm portions of the frame member. This is in contradiction to the general requirement that wheelchairs and especially their frames should be light-weight constructions, where no portion should be over-dimensioned.

#### OBJECT OF THE INVENTION

It is an object of the invention, to propose

- an enhanced frame member for a frame of a wheelchair in form of a letter L, which does not comprise the drawbacks of the prior art members of this type, and
- a frame for a wheelchair comprising at least one of the frame members in accordance with the invention.

#### SUMMARY OF THE INVENTION

This object is attained

- with a frame member in accordance with the invention, comprising the features of claim **1**, and
- with a frame in accordance with claim **12**.

Details and preferred embodiments of the invention are defined in the dependent claims.

The new frame member comprises four elements, (i) a first arm, which is preferably straight or slightly bent and preferably made of a tube, with a first cross section, (ii) a second arm, which is preferably straight or slightly bent, and preferably made of another tube, with a second cross section, (iii) an L-shaped corner element made of a composite, with end areas having curvatures corresponding to the end areas of the first and second arms respectively, and (iv) two portions of a mounting glue to connect firmly the end areas of the corner element with the end areas of the first and second arms respectively. The first cross section (size and/or shape) and the second cross section (size and/or shape) are different.

The stress resistance, i.e. the material and the cross sections of the corner element and the first and second arms, are adapted to the stress they have to bear, so that any over-dimensioning is avoided and the frame member is a lightweight construction.

The cross sections (size and/or shape) of the first and second arms are different, whereby the corner element is shaped to provide for the change in cross section.

The longitudinal axles or central lines of the two arms, which also may be slightly curved, can be in one plane, in parallel planes or in warped planes.

In a preferred embodiment, the first and second arms are hollow and have thin walls, and they may be extruded or deep-drawn; they are preferably made of tubes, with an inner cross section corresponding to outer cross sections of the end areas of the composite corner element. The corner element may be solid or may be tube-like, but then usually with a considerable wall thickness. The end areas of the corner element are introduced in the first and second arms, respectively.

The end areas of the first and second arms usually need not to be specially machined but have the same cross sections than the rest of the arms.

5 Preferably, the form and dimension of the outer surfaces of the end areas of the corner element are equal to the form and dimension of the outer surfaces of the adjacent portions, so that the frame member has a surface without protruding edges.

10 The term 'mounting glue' is used for any gluing or cementing material which is able to connect firmly the arms, which are made of a metal like steel or a material comprising aluminum, magnesium or titanium, with the corner element which is made of a composite material and may comprise reinforcing nets, or fibers like carbon fibers and/or Kevlar, whereby the fibers preferably are positioned along the corner element. The corner element may also comprise plastic. The mounting  
15 glue, however, should not be more brittle than either of the arms and the corner element.

The mounting glue is applied to an area delimited by the end portions of the knee-shaped composite corner element of the first and second tube, respectively, preferably in a recess or cavity in which the mounting glue is mainly situated. It has been found a good solution to position the recess or cavity for the  
20 mounting glue at a surface of the knee-shaped composite corner element.

In cases where the mounting glue is applied after inserting the inner portions of the frame member into the outer portions of the frame member, glue channels  
25 may be necessary to feed the mounting glue to it's appropriate position.

One or all of the surfaces which are in contact with the mounting glue can be slightly structured to enhance the effective contact surface and the effect of the  
30 mounting glue.

Although it is possible to provide for a sufficiently strong connection between the arms and the corner element by means of a mounting glue, it may in certain cases be recommended to provide the surfaces of the arms and the corner element which are in contact with a structure in form of projections and recesses in the mounting direction, whereby the projections and recesses may be straight or may have a spin. By this a rotational movement between meeting elements is prevented.

In addition to the connection by means of mounting glue, it may be recommended in certain cases to use fixation elements like pins or the like to prevent mutual rotating or shifting of the elements which are connected by the mounting glue.

The frame element is used as a part of a frame of a wheelchair. In the assembled wheelchair, preferably one of the arms is in an essentially upright position and the other of the arms is in an essentially horizontal position.

It is a further benefit of the invention, that the arms and/or the corner element are designed in view of their shape and/or dimension and/or stress resistance to allow different other elements of the wheelchair to be affixed to or integral with them, like e.g. a wheelchair seat element, a wheelchair backrest, a wheelchair braking arrangement, a suspension element with front wheel, a foot rest, lever, or bar, or a seat frame portion.

#### BRIEF DESCRIPTION OF THE DRAWINGS

The frame element in accordance with the invention will now be described with reference to the drawings, wherein

**Fig. 1** shows a frame member in a section comprising its curved longitudinal axis, in schematic representation;

**Fig. 2A** shows a portion of a wheelchair with two frame members in accordance with the invention, in a lateral view;

**Fig. 2B** shows the cross section A2 of the essentially vertical arm of the frame member of Fig. 2A, enlarged; and

**Fig. 2C** shows the cross section A1 of the essentially horizontal arm of the frame member of Fig. 2A, enlarged.

#### 10 DESCRIPTION OF THE PREFERRED EMBODIMENTS

A frame member **10**, depicted in **Fig. 1**, comprises a first arm **11** which is made of a straight tube and has a first inner diameter **11.1** and a first outer diameter **11.2** and a second arm **12** which is also made of a tube and has a second inner diameter **12.1** and a second outer diameter **12.2**. The cross sections of the tubes are not necessarily cylindrical, and instead of tubes parts having only hollow end portions may be used.

The frame member **10** further comprises a knee-shaped or corner element **13**. The knee-shaped corner element **13** comprises a first end area **13.1** which is introduced in the first arm **11**, and a second end area **13.2** which is introduced in the second arm **12**. Between and adjacent to its straight end areas **13.1** and **13.2**, the corner element **13** further comprises an effectively knee-shaped or strongly curved area **13.3**. The corner element **13**, in the depicted embodiment, is a solid piece, but it may also be tube-like or it may have cavities.

With a corner element having at least end-areas which are hollow, it is possible to introduce the arms into the corner element instead of introducing the corner element into the arms, whereby the arms in this case can be solid parts.

The outer surface of the first end area **13.1** of the corner element **13** essentially corresponds to the inner surface of the first arm **11**, and, the outer surface of the second end area **13.2** of the element **13** essentially corresponds to the inner

surface of the second arm **12**, so that the frame portion **10** as a whole has a smooth outer surface without any edges.

Not only the diameters, as shown in **Fig. 1**, but also the shapes and dimensions of the first arm **11** and the second arm **12** may be different from each other, as long as a corner element **13**, providing for the necessary change of the cross sections, can be produced with a sufficient stress resistance.

The end portions of the first arm **11** and the second arm **12** are not specially formed, although they may be slightly machined for easier introducing the corner element **13**.

The end portions **13.1** and **13.2** of the corner element **13** have reduced outer diameters which correspond to the inner diameters **11.1**, **12.1** of the arms **11** and **12**, respectively. As already mentioned, the outer diameter of the remaining, effectively cornered area **13.3** of the corner element **13** increases from the outer diameter of the first arm **11** to the outer diameter of the second arm **12**.

The end areas **13.1** and **13.2** of the corner element **13** each comprise for example a recess **13.4** in their surface which faces the adjacent arm **11** or **12**, respectively. The recess **13.4** contains all or at least a major part of a mounting glue **14** by means of which the corner element **13** is connected with the arms **11** and **12**, respectively. Alternately, the recess can be arranged in the end areas of the arms **11**, **12**, or be delimited by one of the arms **11**, **12** and the corner element **13**.

The length of the overlapping portions of the corner element **13** with the arm **11** or **12**, respectively may be around 45 mm, and a medium diameter of the corner element may be around 30 mm.

**Fig. 2A** shows a portion of a wheelchair **20**, with two frame members **10** of the invention and a seat **21**. The frame members **10** each comprise a first arm **11**

made of a tube with a first cross section **A1**, a second arm **12** made of a tube with a second cross section **A2**, and a knee-shaped corner element **13** in form of an inversed letter L made of a composite. The details of the adjacent areas and the connection by mounting glue may correspond to what has been described with relation to **Fig. 1** and are not further explained.

**Fig. 2B** shows the cross section **A1** of the arm **12**, which is streamline shaped.

**Fig. 2C** shows the cross section **A2** of the arm **11**, which has a projection **11.4**, specially designed to mount the seat **21**.

In an advantageous embodiment, the knee-shaped composite element 13 comprises several layers of a reinforced material. These layers comprise glas and/or carbon and/or kevelar fibers as reinforcing material.

In a preferred embodiment, a knee-shaped foam element is used to produce the knee-shaped composite element 13. Well suited is a polyurethan (PU) foam, such as a 2K PU foam, for example, since this foam forms closed pores. Several layers are applied on the knee-shaped foam element and are treated with a resin that hardens. The layers may have the form of socks which are put on the knee-shaped foam element. Preferably, the knee-shaped foam element with one or more layers applied is put in a tool that allows the resin to be injected. After the resin is hardened, the tool is opened to remove the knee-shaped composite element 13. According to this preferred embodiment, the foam element remains inside the knee-shaped composite element 13 and provides for additional stability.

Best results have been achieved with 3 or 4 layers of reinforcing material. Depending on the kind of resin used, it is advantageous to apply a thin finishing layer that serves as UV protection. The resin and/or the finishing layer may be colored using pigments or dyes.

